

Bonn. zool. Beitr.	Bd. 39	H. 1	S. 59—72	Bonn, März 1988
--------------------	--------	------	----------	-----------------

A new look at the shrews (Soricidae) of Arabia

R. Hutterer & D. L. Harrison

Abstract. Two species of *Suncus* and five species of *Crocidura* are known from Arabia. Notes on morphology and new distributional records are given in this review. *Crocidura suaveolens* is recorded from Saudi Arabia, and two new taxa are described from Oman and South Yemen. The present shrew fauna of Arabia is a result of different immigrations from Eurasia, Africa, and tropical Asia. The two relic species of southern Arabia probably originate from Pliocene immigrations from East Africa.

Key words. Mammalia, Soricidae, Arabia, taxonomy, distribution, biogeography.

Introduction

Records of shrews from the Arabian peninsula were very scarce until Harrison (1980) and Bates & Harrison (1984) reported on new material, particularly from southern Arabia, that provided significant new information on the distribution of these little known mammals. However, a recent re-investigation of these specimens by the senior author revealed that some of them were not correctly identified and that the material from southern Arabia named *Crocidura suaveolens* in these publications represents a striking new species apparently endemic to Arabia. We therefore review here all the species of Soricidae which occur on the Arabian peninsula and try to ascertain their zoogeographical origins. Some new or unrecorded specimens are included. The geographical setting followed by us is the same as in Harrison (1964 ff.).

The main part of the material we report about is in the Harrison Zoological Museum, Sevenoaks (= HZM); other material was studied at the British Museum (Natural History), London (= BM), the Naturhistorisches Museum Wien (= NMW), and the Zoologisches Forschungsinstitut und Museum Alexander Koenig, Bonn (= ZFMK).

The shrews of Arabia

Family Soricidae Gray, 1821

Genus *Suncus* Ehrenberg, 1832

Suncus etruscus (Savi, 1822)

Sorex etruscus Savi, 1822. — Nuovo Giorn. Letterati 1: 60.

Material: BM 67.1253 (unsexed). 25. IV. 1967, Socotra Island, South Yemen, 2800 feet (853 m), 12° 30' N, 54° 00' E; collected by K. M. Guichard.

This new record extends the distribution of the pygmy shrew considerably into SW direction (see maps in Kock & Nader 1983, and Bates & Harrison 1984). There are now four records of pygmy shrews in southern Arabia including Socotra, but only

a single record from East Africa (Bahar-Dar, Ethiopia; Corbet & Yalden 1972). This indicates that the species reached Arabia from Asia rather than Africa.

Suncus murinus (Linnaeus, 1766)

Sorex murinus Linnaeus, 1766. — Syst. Nat., 12th ed., 1: 74.

Material: HZM 39.17737 ♀, 12. I. 1984, A'Ali Village, Bahrain, c. 26° 03' N, 50° 33' E; HZM 41.17782 ♀, 27. IV. 1984, Ras Rumman; Bahrain; both coll. A. D. Khalili; HZM 30.14038 ♀, 38.17488 ♂, 12. III. 1984, 40.17781 ♀, 1986, Jeddah (town), 21° 30' N, 39° 10' E, Saudi Arabia; all coll. J. Gasperetti. — Other material listed by Bates & Harrison (1984).

The Asian house shrew is well known as a ship-borne commensal species from seaports and capitals along the Arabian coasts. However, nothing is known about the origin of the Arabian populations and about the time they were brought into the peninsula. Also their taxonomy remains a problem; Cheesman (1920), Harrison (1972) and Gallagher & Harrison (1984) suggested that there may be two different species in Arabia. The fairly large material (26 specimens) we now have at hand indicates a strange morphological variation of the shrews with regard to sex and geography (Fig. 1). Within one population, males are always larger than females. However, both in males and females the external and cranial measurements decrease from Iraq in the north to Saudi Arabia in the south (Tab. 1). Specimens from Basra, Iraq, are largest in body and skull measurements and they have a medium greyish-brown pelage. Specimens from Bahrain are slightly smaller but have considerably longer tails. A real difference exists between these two populations and specimens from Jeddah, Saudi Arabia. They are very small and have a very pale, light-grey pelage. The strong differences between Basra and Jeddah house shrews would indicate two different species but intergrading specimens from Muscat, Oman and Aden, South Yemen show that there is only one species which however varies geographically in colour and size. The beautiful light-grey colour of the Jeddah sample is not matched by any other specimen from Arabia but by some specimens from East Africa (Hutterer, unpubl.). We therefore think that the present Arabian populations of *Suncus murinus* originate from at least two main invasions: one from (?northern) India into the Arabian Gulf and to Iraq and Bahrain, and another one from Africa across the Red Sea into Yemen and Saudi Arabia.

Table 1: Some external and cranial measurements of adult *Suncus murinus* from Iraq (Basra), Bahrain, South Yemen (Aden) and Saudi Arabia (Jeddah), taken from specimens in the Harrison Zoological Museum and the British Museum (Natural History). Single values and means in millimetres.

Measurement	Basra		Bahrain		Aden		Jeddah	
	1 ♀	5 ♂	5 ♀	1 ♂	2 ♂	2 ♀		
Total length	TL	213.5	213.2	190.8	198.0	174.0	157.0	
Tail length	T	70.5	82.8	76.0	76.0	69.5	59.0	
Hindfoot length	HF	21.0	21.9	19.2	22.0	18.85	17.95	
Ear length	E	15.0	14.0	12.8	14.0	11.25	10.8	
Condylo-incisive l.	CI	35.1	33.2	30.5	30.7	31.1	29.2	
Upper toothrow length	UTRL	15.6	14.1	13.3	13.6	13.3	12.4	

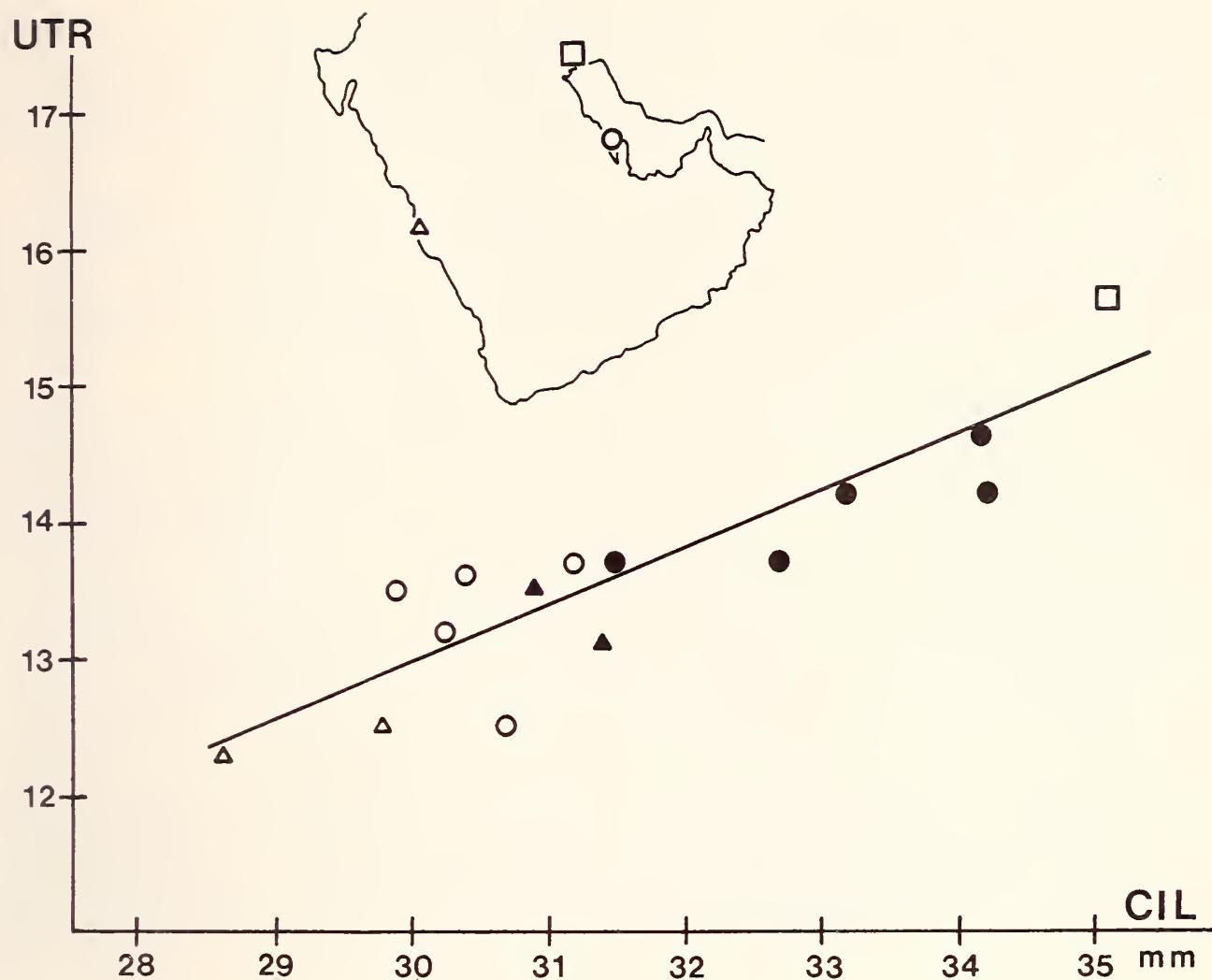


Fig. 1: Geographical and sexual variation of skull size (condylo-incisive length plotted against upper toothrow length) in Arabian *Suncus murinus*. Open symbols = females, black symbols = males; square: Basra, Iraq; circles: Bahrain; triangles: Jeddah, Saudi Arabia.

Genus *Crocidura* Wagler, 1832

Crocidura leucodon (Hermann, 1780)

Sorex leucodon Hermann, 1780. — In Zimmermann, Geogr. Gesch., 2: 382.

No additional material has become available to us since Atallah's (1977) review. South of Turkey the species is only known from a few localities in Lebanon and Palestine. These populations are referred to the subspecies *C. l. judaica* Thomas, 1919 (Harrison 1964; Atallah 1977).

Crocidura lasia Thomas, 1906

Crocidura leucodon lasia Thomas, 1906. — Ann. Mag. nat. Hist. 17: 416.

In its short history this form has been subject to frequent changes. Atallah (1977) was the last who summarized the different views. According to him, only four specimens are known from Lebanon, although many more specimens have been collected in Turkey, Greece and Russia. We have re-examined his material from Lebanon in order to find characters other than size which might distinguish *C. lasia* from the

very similar *C. leucodon*, but like many preceding authors we have failed in discovering something special. This again raises some doubt about the taxonomic status of this form. A clear decision probably must await additional information on the karyotype.

***Crocidura suaveolens* (Pallas, 1811)**

Sorex suaveolens Pallas, 1811. — Zoogr. Rosso-Asiat., 1: 133.

Material: HZM 83.11004 (unsexed), skin and skull, 3. XI. 1979, Camp 4, near Bani Mashoor, 22° 50' N, 42° 09' E, Saudi Arabia; coll. R. Fraser.

This unique specimen, reported as *C. russula* (Hermann, 1780) by Bates & Harrison (1984), is the first record of *C. suaveolens* from Saudi Arabia (Fig. 2). Until recently the species has been confused with *C. russula* in the Near East, Arabia and even in the Far East. However, since the work of Catzeffis et al. (1985) we know that the two morphotypes distinguished by numerous authors in the Near East are in fact a single species with a karyotype of *C. suaveolens* ($2N = 40$, $NF = 50$). In consequence, all specimens recorded by earlier authors under the names *russula*, *monacha*, *gueldenstaedti*, or *portali* do probably belong to the species *Crocidura suaveolens*. In Fig. 4 we present a map of the records which we assign to this species. The map is based on Andera (1972), Atallah (1977), Catzeffis et al. (1985), Harrison (1964, 1972), Hellwing (1973), Lay (1967), Nader (1969), Osborn & Helmy (1980), Setzer (1960), Simsek (1980), Spitzemberger (1970) and Vereshchagin (1967). In addition we have mapped two hitherto unrecorded specimens from Iran: HZM 11.6142 from Lake

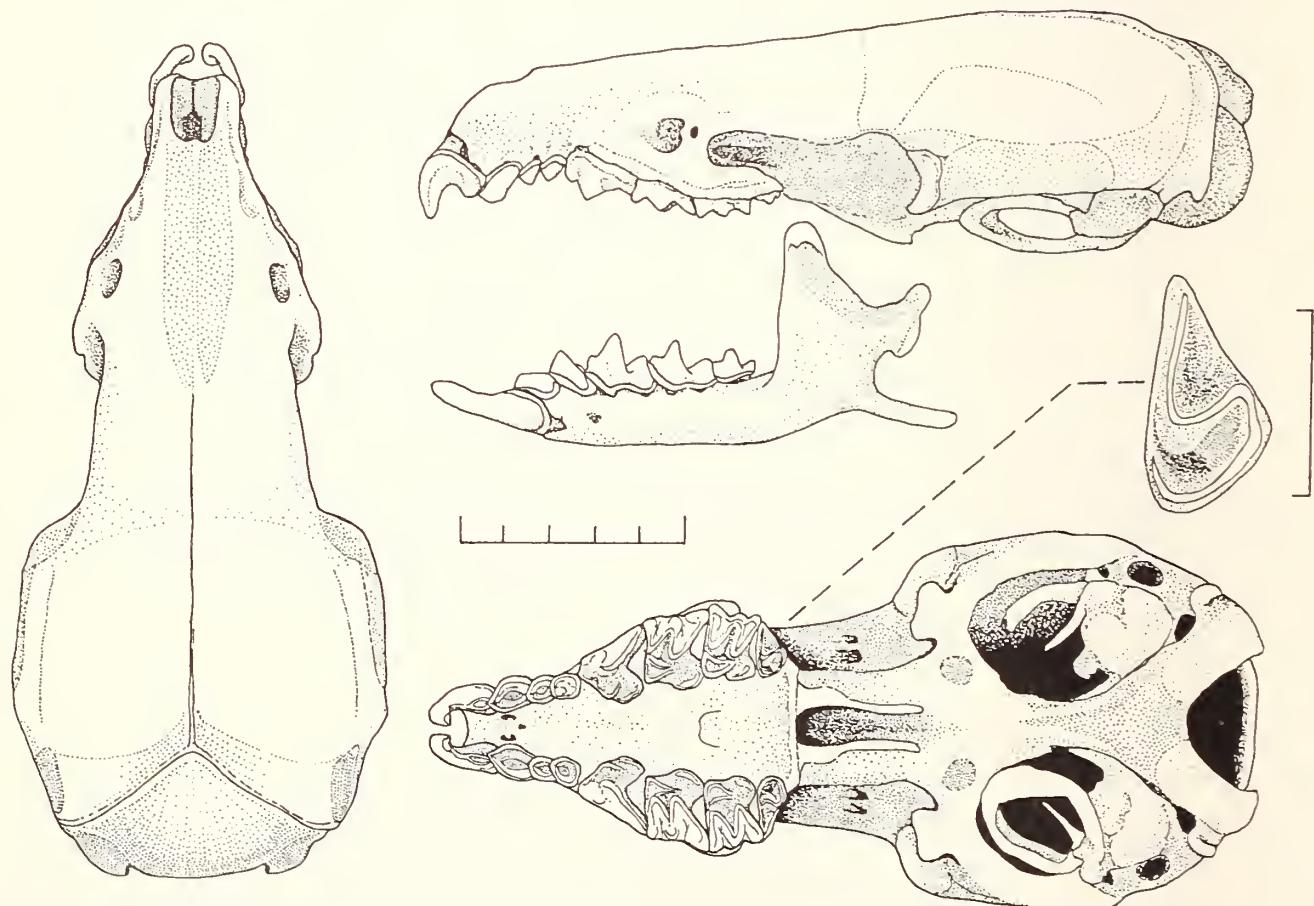


Fig. 2: Skull and mandible of *Crocidura suaveolens* from Bani Mashoor, Saudi Arabia (HZM 83.1104). Scale is 5 mm and 1 mm (enlarged M³).

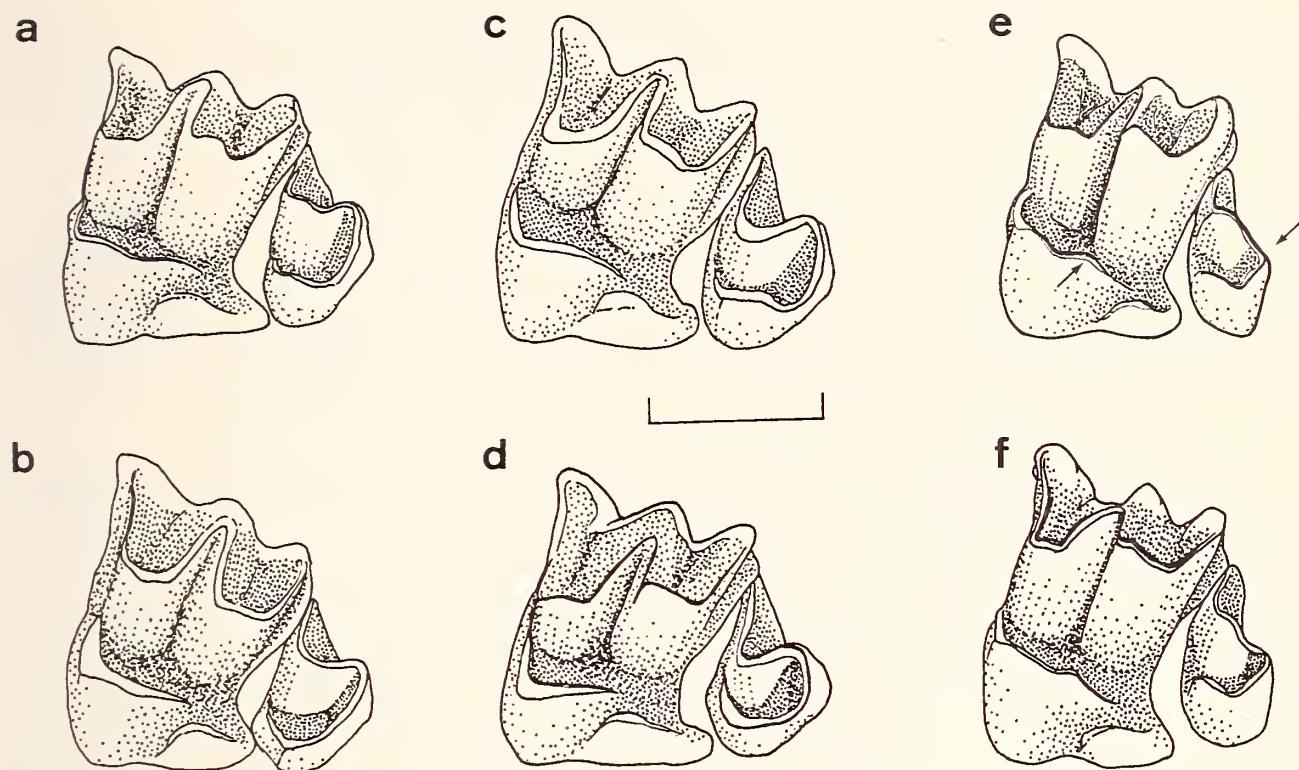


Fig. 3: Lingual view of M^{2-3} in specimens of *Crocidura suaveolens* (a—d) and *C. arabica* n. sp. (e—f). Note the reduction of the M^3 and the additional cusplet on M^2 in *C. arabica*. Specimens are from (a) Sewastopol, Crimea, S Russia, NMW 20214; (b) Lake Tashk, Fars, Iran, HZM 11. 6142; (c) Sereni, Israel, HZM 79.10085; (d) Bani Mashoor, Saudi Arabia, HZM 83.1104; (e) Khadrafi, Dhofar, Oman, HZM 27.9150, holotype; (f) Jabal Qara, Dhofar, Oman, HZM 16.8640, paratype. Scale is 1 mm.

Tashk, Fars Province, and ZFMK 85.155 from Maigoon, Elburz Mountains. The new record from Saudi Arabia extends the distribution of *C. suaveolens* considerably to the south. As already noted by Bates & Harrison (1984) the single specimen may represent an isolated population within Saudi Arabia. However, it may also be possible that further records will be found in higher altitudes north and even south of Bani Mashoor. There are mountains all the way down from Jordan to South Yemen which could support populations of shrews.

The skull of the Saudi Arabian shrew is shown in Fig. 2. The skull shows all typical features of European and Far Eastern *C. suaveolens*, namely the short and stout skull, broad interorbital region, large braincase, short upper and lower incisors, tips of unicuspids in one line with the paracone tip of the fourth upper premolar, the paracone closely attached to the upper premolar, and the third upper molar very large, particularly in its posterior part. We found the last character to be very typical for the species throughout its range (Fig. 3). It also appears to us now that the antorbital foramen of the cranium is very small in *C. suaveolens* in comparison with European *C. russula*.

As the type locality of *C. suaveolens* is Khersones in Crimea, S Russia, we checked the above mentioned characters also in a specimen from the type region. As an example, Fig. 3 shows second and third upper molars of specimens from S Russia, Iran, Palestine and Saudi Arabia. Despite the size differences (which obviously exist between different geographical populations) the dental characters are the same. The

figure also shows that the specimens from Oman reported as *C. suaveolens* by Harrison (1980) and Bates & Harrison (1984) belong to a different taxon, which we describe below.

Crocidura arabica n. sp.

Material: Holotype: HZM 27.9150, skin and skull of a young adult shrew (unsexed), 30. IX. 1977, Khadrafi, 16° 42' N, 53° 09' E, Dhofar, Oman; coll. J. B. Sale. — Paratypes: HZM 16.8640, skull and body in spirit, Jabal Qara, c. 17° 00' N, 54° 30' E, Dhofar, coll. J. P. Mandaville 23. IX. 1976; HZM 17.8765—26.8774, partial crania and mandibles from ?owl pellets,

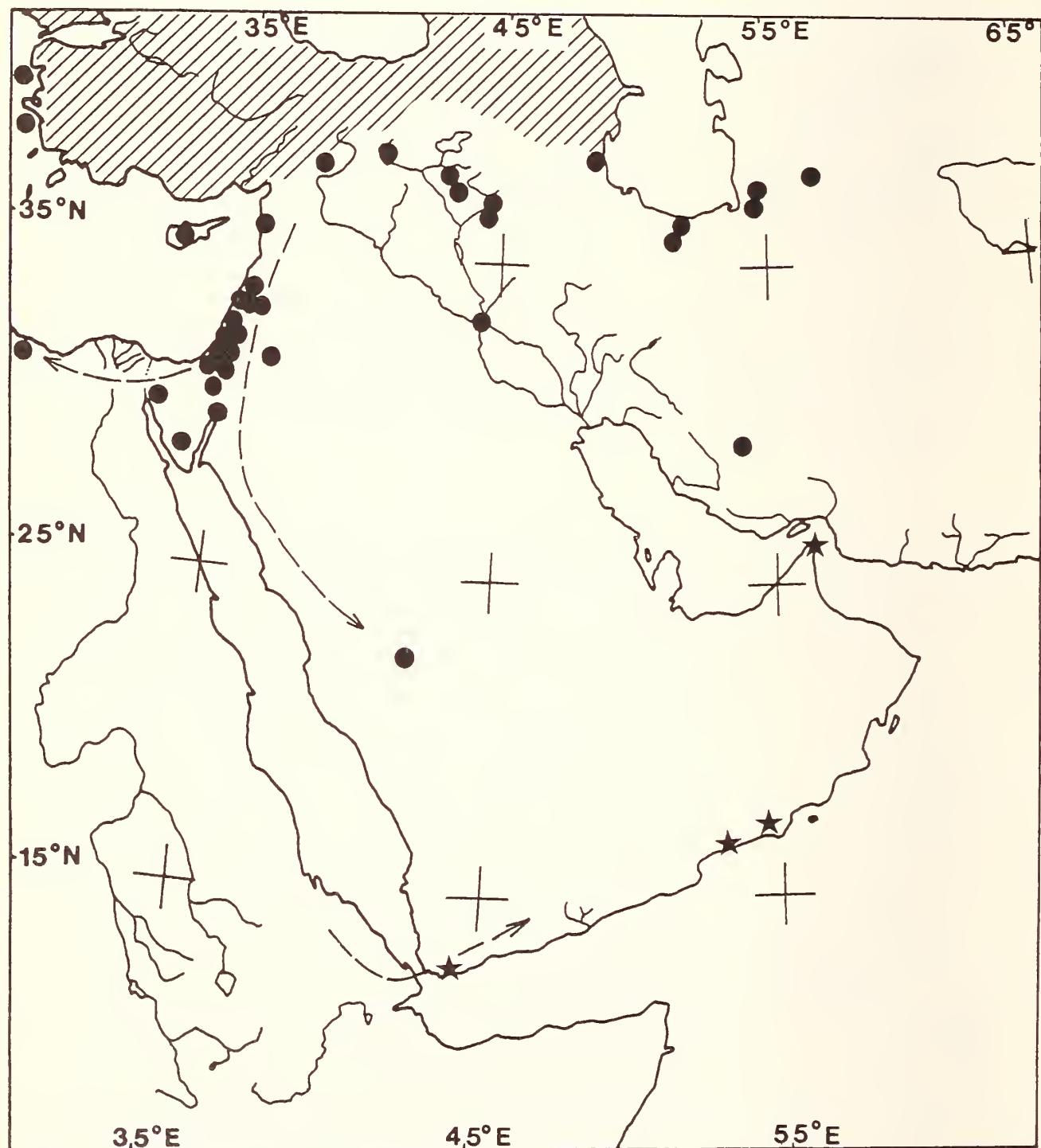


Fig. 4: Known distribution of *Crocidura suaveolens* (dots/single records and hatching/continuous distribution) and *C. arabica* n. sp. (stars). Dashed lines and arrows indicate the direction of hypothetical immigration routes.

from Tawi Atair, Jabal Samhan, $17^{\circ} 05' N$, $54^{\circ} 34' E$, Dhofar, coll. M. D. Gallagher 9. IV. 1977; HZM 32.13034, skull and body in spirit, Birkat Khaldiya, $26^{\circ} 02' N$, $56^{\circ} 22' E$, Sal al A'la, Wadi Khasab, Musandam Region, Oman, coll. P. R. Sichel 13. I. 1983. — Referred material: BM 85.5.4.1, skull and spirit specimen of a juvenile, Aden, $12^{\circ} 50' N$, $45^{\circ} 03' E$, South Yemen, coll. J. W. Yerbury 1895.

Diagnosis: Distinguished from all other Arabian shrews by small size, mouse grey colouration, and by a highly reduced third upper molar (Fig. 3).

Measurements: Table 2; see also Harrison (1980) and Bates & Harrison (1984).

Description: A small terrestrial *Crocidura* with short hindfoot (9.7—10.1). Tail 74 % of head and body length. Outer ears rather large (Fig. 5) and standing off the head as in some *Suncus* or in some African savanna *Crocidura*. General colour mouse grey, dorsally with a brownish tinge, ventrally light grey, with the line of demarcation on the flanks indistinct. Dorsal surfaces of hands and feet of the same colour as the body but slightly paler. Tail uniformly greyish-brown, covered by long bristle hairs over 75 % of its length. Pelage hairs short, measuring 3 mm at dorsum.

Skull (Fig. 6) slender, particularly the rostrum and the interorbital region; this part gradually broadening from snout towards braincase. Dentition: I^1 rather long and blade-like, with a well developed posterior cusp. U^1 twice as large as U^{2-3} , oval shaped in ventral view. U^{2-3} of equal size, their tips in one line with the paracone tip of P^4 . M^{1-2} rather short; both teeth have an additional small cusplet between protocone and hypocone (Fig. 3, e—f), a rather uncommon feature among *Crocidura*¹). M^3 is reduced to a slim pin (Fig. 6). The cutting surface of I_1 is slightly undulated, not smooth.

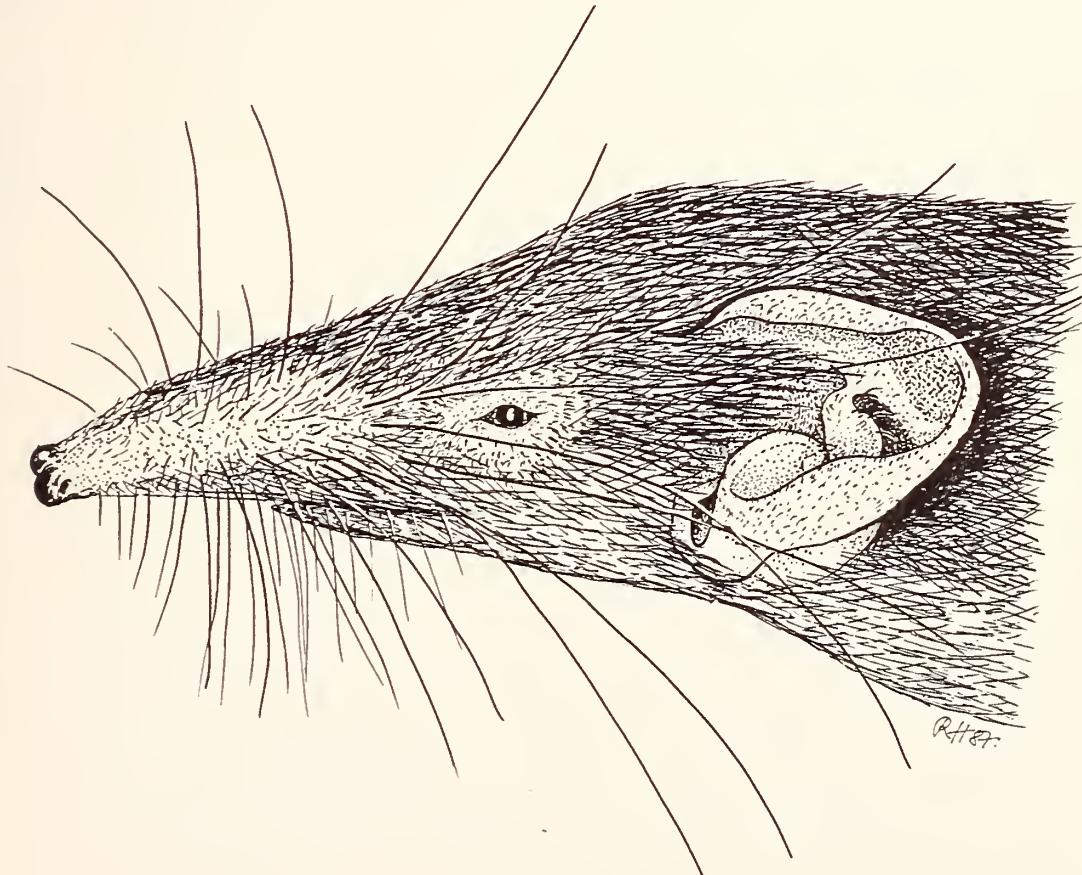


Fig. 5: Sketch of the head of *Crocidura arabica* n. sp. based on HZM 16.8640, paratype. Note the prominent ears.

¹) *Crocidura susiana* Redding & Lay, 1978, of southern Iran is characterized by the presence of such additional cusplets on M^{1-2} .

Table 2: Measurements (in mm) of three species of *Crocidura* from Saudi Arabia and Oman.

Measurement	<i>C. suaveolens</i> HZM 83.11004			<i>C. arabica</i> n. sp. HZM 27.9150			<i>C. s. dhofarensis</i> n. ssp. HZM 1.9149		
	Saudi Arabia			Oman			Oman		
Head and body length	HB	62	55	ca. 51	54	68			
Tail length	T	43	41	36	41	47			
Pilosity of tail (%)		81.4	73.2	77.8	—	74.5			
Hindfoot length	HF	11.7	10.1	9.9	—	11.6			
Ear length	E	6.0	7.8	7.6	7.3	9.3			
Skull:									
Condylar-incisive length	CI	18.1	17.7	17.8	17.8	17.8			
Basal length	BL	16.4	15.9	16.1	15.8	18.5			
Palatal length	PL	7.3	7.3	7.4	7.2	8.5			
Greatest width	GW	8.1	7.7	7.6	7.4	8.5			
Bimaxillary width	BW	5.4	5.4	5.3	4.8	5.7			
Least interorbital w.	LIW	4.2	3.6	3.8	3.8	3.8			
Posterior median height	PMH	4.4	3.9	3.9	4.0	4.5			
Upper toothrow length	UTRL	7.8	7.6	7.7	7.4	8.6			
Lower toothrow length	LTRL	7.0	7.1	7.1	6.9	7.7			
Coronoid process height	COR	4.4	4.2	4.2	4.2	5.0			
Width of M^3	M^3-W	1.17	1.05	1.11	1.02	1.23			
Length of M^3	M^3-L	0.60	0.42	0.48	0.48	0.51			

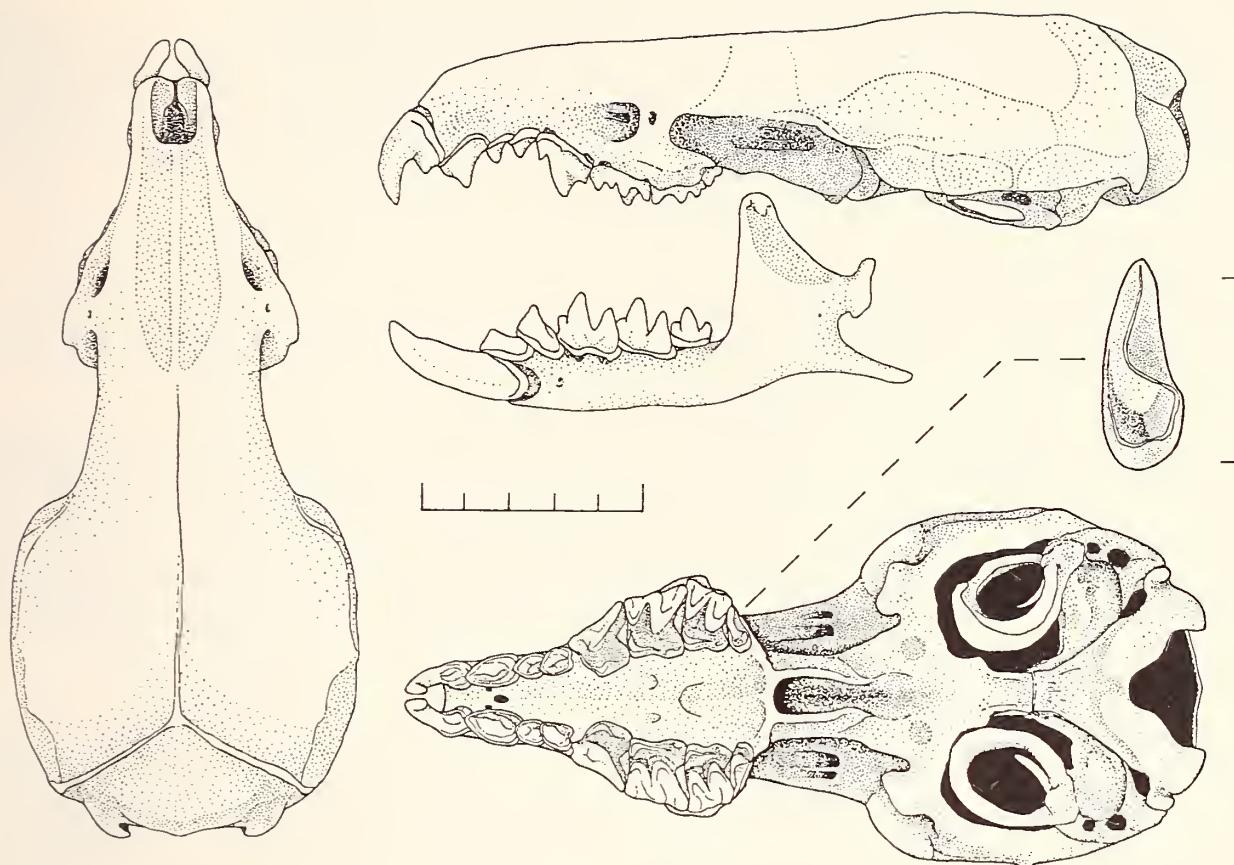


Fig. 6: Skull and mandible of *Crocidura arabica* n. sp. (HZM 27.9150, holotype). Scale is 5 mm and 1 mm (enlarged M^3).

Etymology: Named for Arabia, the geographic region to which the new species is apparently confined.

Distribution: Known so far from three localities in Oman and one in South Yemen (Fig. 4).

Habitat: The holotype was collected in a south-facing slope covered by trees and long grass. One paratype was collected in a coastal plain covered by dense grassland. These localities are known for their high quantity of endemic plants (Radcliffe-Smith 1980).

Remarks: The specimens were first mentioned by Harrison (1980) under the name *C. suaveolens*. A comparison of cranial and dental characters (Figs. 2, 3, 6) clearly shows that two different taxa are involved. Several characters of the new species point to an African origin. The most obvious character, the highly reduced M^3 , is only matched by the species of the subgenus *Afrosorex* (Hutterer 1986), and to a lesser extent by some African savanna shrews. The long and diverging interorbital region is also found in several African but not in Eurasian *Crocidura*. The mouse grey pelage is shared by *C. floweri* Dollman, 1915 and *C. religiosa* (Geoffroy, 1827) of Egypt. *Crocidura floweri* may be the nearest relative of *C. arabica* n. sp.; colouration, body size and cranial dimensions agree quite well. However, *C. floweri* has a well developed third upper molar. The species is now endemic to northern Egypt (Osborn & Helmy 1980). *C. floweri* is probably related to *C. crossei* Thomas, 1895, a common species in forest and savanna of West Africa (Hutterer & Happold 1983). Skull and dentition of *C. crossei* show more derived characters than *C. floweri*. We suggest that

a species close to *C. floweri* gave rise to *C. crossei* and possibly also to *C. arabica* n. sp. A landbridge across the Red Sea was present until the Pliocene (Girdler & Styles 1974). *C. arabica* n. sp. and a further form described below are probably relicts of that period.

Crocidura somalica dhofarensis n. subsp.

Material: Holotype: HZM 1.9149, skin and skull of an adult male, Khadrafi, 16° 42' N, 53° 09' E, 620 m, Dhofar, Oman, coll. J. B. Sale X. 1977.

Diagnosis: Similar to *C. somalica* Thomas, 1895, in external and cranial measurements but differing in: colour of ventral pelage dark brown (instead of clearly grey), dorsal surface of hands and feet brownish (instead of white), tail unicoloured (not bicoloured); skull very slender, rostrum long and narrow, palate, bimaxillary, interorbital, and interpterygoid space distinctly narrower than in African *C. somalica* (Fig. 7).

Measurements: Table 2.

Description: The general colour of the holotype skin is deep olive-brown, with a slightly more greyish tone along the ventral side. A small portion of hair below the chin is whitish. A 3.5 mm wide area of lighter coloured hairs at the right flank indicates the presence of a side gland. The length of the hair at dorsum is 3.5 mm. Ears, hands and feet are dark coloured. The tail, also brown, is covered by long bristle hairs over c. 75 % of its length. The skull (Fig. 7; dorsal and lateral views also figured by Harrison 1980: 389) is extremely slender. For example, the interpterygoid space is 0.69 mm wide in the holotype of *dhofarensis* but 0.88 (0.84—0.90; n = 5) in Ethiopian *somalica*; the bimaxillary width is 5.7 in *dhofarensis* and 6.2 (5.9—6.6; n = 5) in *somalica* (material from Awash N. P., Ethiopia, in ZFMK). The third upper molar is rather slender and shows an advanced configuration. The posterior surface of the condylar process of the mandible is stronger angled than in *somalica* (Fig. 7).

Distribution, Etymology: Only known from Khadrafi, Dhofar; the name for the new taxon is derived from that region.

Habitat: The holotype specimen was trapped by Dr J. B. Sale in long grass at an altitude of 620 m. The camp site of the 1977 Oman Flora and Fauna Survey expedition has been figured by Radcliffe-Smith (1980: 70, pl. 9) and Gallagher & Rogers (1980: 356, pl. 2). The expedition camped at the base of a steep south-facing slope of the Jabal Qamr which was covered by forest with some open grassland in between.

Remarks: The unique specimen was tentatively assigned to *C. somalica* by Harrison (1980) and Hutterer & Jenkins (1983). However, a more detailed comparison of the Oman shrew with abundant material of African *C. somalica* has revealed a set of characters (see Diagnosis) not covered by the variation of *C. somalica* proper. Particularly the long and narrow rostrum and the extremely narrow interpterygoid space are so unique that we now think that the Oman shrew represents a different taxon. Because of general similarity with *C. somalica* we describe it here as a subspecies of the latter but we do not exclude the possibility that the taxon may deserve even species status, but this decision must await further material from Arabia. What seems sure to us are the African affinities of this Oman shrew. In addition to *C. somalica*, similarities in skull shape and dentition exist between *C. s.*

dhofarensis and *C. roosevelti* (Heller, 1910), *C. greenwoodi* Heim de Balsac, 1966, and *C. fulvastra* (Sundevall, 1843), all of them inhabitants of moist or dry savanna. The very special habitat (relic forest slope) of *C. s. dhofarensis* may indicate that the species is at present a relic of an ancient immigration from tropical Africa.

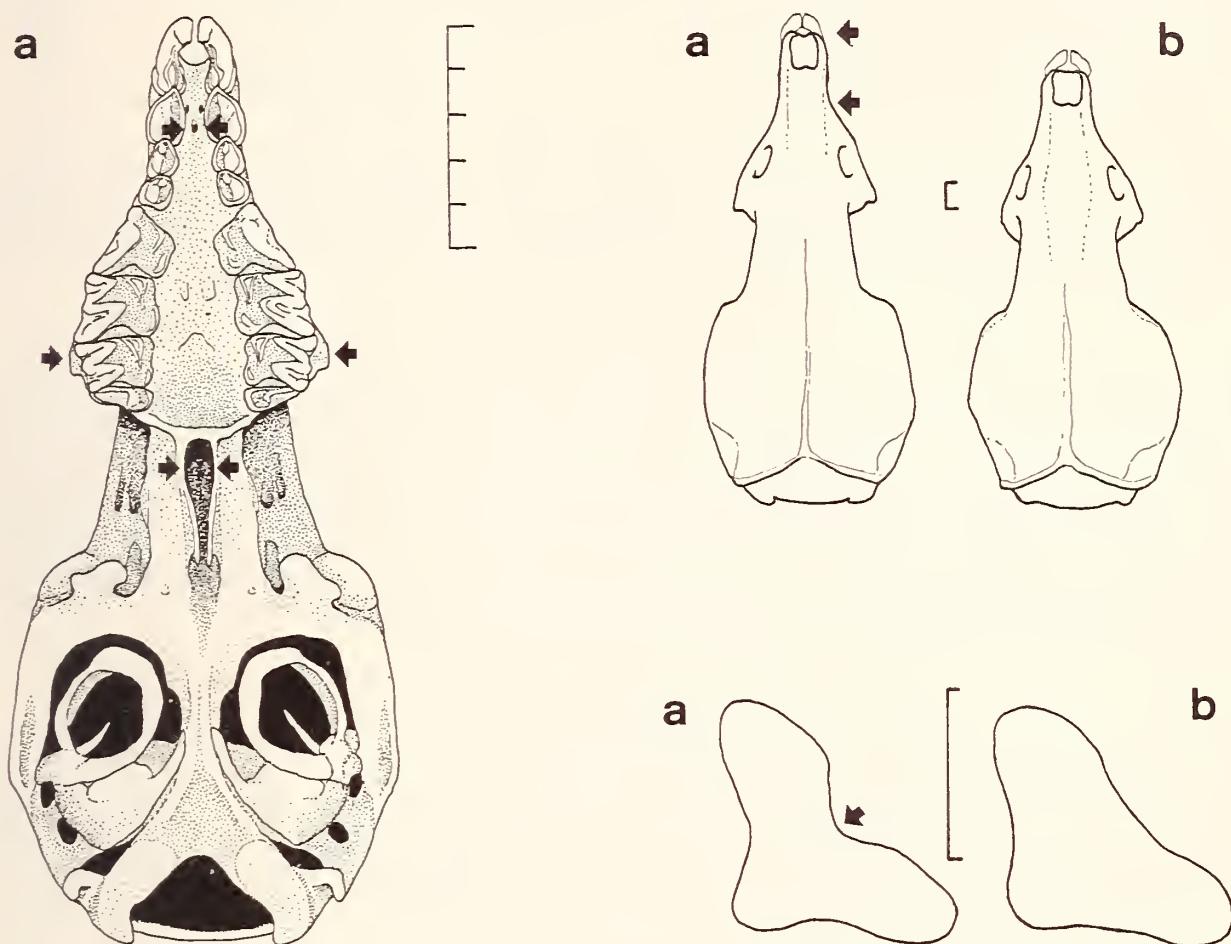


Fig. 7: Ventral and dorsal view of the skull and of the posterior surface of the condylar process of the mandible of *Crocidura somalica dhofarensis* n. subsp. (HZM 1.9149, a); for comparison the holotype of *C. somalica somalica* (BM 93.6.30.7) is shown (b). Scales are 5 mm (left side) and 1 mm (right side).

Conclusions

Of the seven species of shrews which occur in the Arabian peninsula including Iraq, Syria, Lebanon, Jordan and Palestine, two (*C. leucodon*, *C. lasia*) are known only from Lebanon. These evidently are species of temperate Eurasia which do not occur further south. *Crocidura suaveolens* and *Suncus etruscus* are also centred in Eurasia in their distribution, but these shrews are better adapted to arid conditions. Both have entered Arabia, and small parts of Africa as well. *Suncus murinus* is an Asian element whose actual distribution has been greatly influenced by human activity. However, our observations show that the Arabian populations exhibit a rather complex picture of morphological variation, suggesting at least two different immigration routes.

Finally, the newly described *Crocidura arabica* belongs in the group of Arabian endemic mammals, although its phylogenetic relations clearly are in Africa. The

same applies to *C. somalica dhofarensis*, which may turn out to be another Arabian endemic with African roots. The last two shrews may be added to the list of southern Arabian mammals whose counterparts occur in tropical Africa. These include *Praomys fumatus*, *Arvicantis niloticus*, *Papio hamadryas*, *Ichneumia albicauda*, *Genetta felina*, and *Tragelaphus imberbis* (Harrison 1964–1972; Büttiker 1982; Gasperetti et al. 1985). The small insectivore faunula therefore nicely reflects the long history of the Arabian peninsula.

Acknowledgements

We express our sincere thanks to the curators and staff members of the museums where we studied material, particularly to Miss Paula Jenkins and to Mrs Friederike Spitzenberger. We also like to thank Peter Vogel for his critical remarks on this text.

Zusammenfassung

Zwei Arten der Gattung *Suncus* und fünf Arten der Gattung *Crocidura* kommen in Arabien vor. *Suncus etruscus* wird für die Insel Sokotra, *Crocidura suaveolens* für Saudi Arabien erstmals nachgewiesen. Zwei neue Taxa werden aus Oman und Süd-Jemen beschrieben. Die gegenwärtige Spitzmaus-Fauna der Arabischen Halbinsel wird als Resultat verschiedener Einwanderungswellen aus Eurasien, Afrika und dem tropischen Asien erklärt. Zwei Reliktarten der südarabischen Küstenländer Oman und Süd-Jemen stammen wahrscheinlich von Formen ab, die im Pliozän aus Ostafrika über das Rote Meer einwanderten.

References

Anděra, M. (1972): Notes on white-toothed shrews from Iraq (Mammalia: Insectivora, Soricidae). — *Věst. Čs. spol. zool.* 36: 81–88.

Atallah, S. I. (1977): Mammals of the Eastern Mediterranean region: their ecology, systematics and zoogeographical relationships. — *Säugetierkd. Mitt.* 25: 241–320.

Bates, P. & D. L. Harrison (1984): Significant new records of shrews (Soricidae) from the southern Arabian peninsula, with remarks on the species occurring in the region. — *Mammalia* 48: 144–147.

Büttiker, W. (1982): Mammals of Saudi Arabia. The Lesser Kudu (*Tragelaphus imberbis*) (Blyth 1869). — *Fauna of Saudi Arabia* 4: 483–487.

Catzeffis, F., T. Maddalena, S. Hellwing & P. Vogel (1985): Unexpected findings on the taxonomic status of East Mediterranean *Crocidura russula* auct. (Mammalia, Insectivora). — *Z. Säugetierkunde* 50: 185–201.

Cheesman, R. E. (1920): Report on the mammals of Mesopotamia, collected by members of the Mesopotamian Expedition Force 1915–1919. — *J. Bombay nat. Hist. Soc.* 27: 323–346.

Corbet, G. B. & D. W. Yalden (1972): Recent records of mammals (other than bats) from Ethiopia. — *Bull. Br. Mus. nat. Hist. (Zool.)* 22: 213–252.

Gallagher, M. & D. L. Harrison (1974): The terrestrial mammals of Bahrain. — *J. Bombay nat. Hist. Soc.* 72: 407–421.

— & T. D. Rogers (1980): On some birds of Dhofar and other parts of Oman. — *J. Oman Stud. Spec. Rep.* No 2: 347–385.

Gasperetti, J., D. L. Harrison & W. Büttiker (1985): The Carnivora of Arabia. — *Fauna of Saudi Arabia* 7: 397–461.

Girdler, R. W. & P. Styles (1974): Two stage Red Sea floor spreading. — *Nature* 247 (5435): 7–11.

Harrison, D. L. (1964): The mammals of Arabia. 1. Insectivora, Chiroptera, Primates. — Benn, London, pp. 192.

— (1972): Appendix IV in: The mammals of Arabia. 3. Lagomorpha, Rodentia. — Benn, London, pp. 626–629.

— (1980): The mammals obtained in Dhofar by the 1977 Oman flora and fauna survey. — *J. Oman Stud. Spec. Rep.* No 2: 387—397.

Hellwing, S. (1973): Husbandry and breeding of white-toothed shrews (Crocidurinae) in the Research Zoo of the Tel-Aviv University. — *Int. Zoo Yearb.* 13: 127—134.

Hutterer, R. (1986): African shrews allied to *Crocidura fischeri*: taxonomy, distribution and relationships. — *Cimbebasia* (A) 8: 23—35.

— & D. C. D. Happold (1983): The shrews of Nigeria (Mammalia: Soricidae). — *Bonn. zool. Monogr.* 18: 1—79.

— & P. D. Jenkins (1983): Species-limits of *Crocidura somalica* Thomas, 1895 and *Crocidura yankariensis* Hutterer and Jenkins, 1980 (Insectivora: Soricidae). — *Z. Säugetierkunde* 48: 193—201.

Kock, D. & I. A. Nader (1983): Pygmy shrew and rodents from the Near East (Mammalia: Soricidae, Rodentia). — *Senckenbergiana biol.* 64: 13—23.

Lay, D. M. (1967): A study of the mammals of Iran. — *Fieldiana: Zoology* 54: 1—282.

Nader, I. A. (1969): Records of the shrew, *Crocidura russula*, from Iraq. — *J. Mammalogy* 50: 614—615.

Osborn, D. J. & I. Helmy (1980): The contemporary land mammals of Egypt (including Sinai). — *Fieldiana: Zoology, N. S.* 5: 1—579.

Radcliffe-Smith, A. (1980): The vegetation of Dhofar. — *J. Oman Stud. Spec. Rep.* No 2: 59—86.

Redding, R. W. & D. M. Lay (1978): Description of a new species of shrew of the genus *Crocidura* (Mammalia: Insectivora: Soricidae) from southwestern Iran. — *Z. Säugetierkunde* 43: 306—310.

Setzer, H. W. (1960): Two new mammals from Egypt. — *J. Egypt. Publ. Health Assn.* 35: 1—5.

Simsek, N. (1980): Turklye *Crocidura suaveolens* (Pallas, 1811) ve *Crocidura russula* (Hermann, 1780) 'larinin (Mammalia: Insectivora) diskriminant analiz yöntemi ile ayıredilmesi. *Tubitak VII. Bilim Kongressi* 6—10 Ekim 1980 Kusadasi-Aydin: 417—432.

Spitzenberger, F. (1970): Zur Verbreitung und Systematik türkischer Crocidurinae (Insectivora, Mammalia). — *Ann. naturhistor. Mus. Wien* 74: 233—252.

Vereshchagin, N. K. (1967): The mammals of the Caucasus. — Israel Program for Scientific Transl., Jerusalem, pp. 816.

Dr. Rainer Hutterer, Zoologisches Forschungsinstitut und Museum Alexander Koenig, Adenauerallee 162, D-5300 Bonn 1, F. R. Germany.

Dr. David L. Harrison, Harrison Zoological Museum, St. Botolph's Road, Sevenoaks, Kent TN13 3AQ, England.

ZOBODAT - www.zobodat.at

Zoologisch-Botanische Datenbank/Zoological-Botanical Database

Digitale Literatur/Digital Literature

Zeitschrift/Journal: [Bonn zoological Bulletin - früher Bonner Zoologische Beiträge.](#)

Jahr/Year: 1988

Band/Volume: [39](#)

Autor(en)/Author(s): Hutterer Rainer, Harrison David L.

Artikel/Article: [A new look at the shrews \(Soricidae\) of Arabia 59-71](#)